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Materiel Test Procedure 9-2-207
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

LATHES

1. OBJECTIVE*

This document provides test methodology and testing techniques necessary to determine the technical performance and safety characteristics of lathes and associated tools and equipment as described in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), and Technical Characteristics (TC's), and to determine the item's suitability for service tests.

2. BACKGROUND

The lathe is probably the most versatile and widely used tool in the complement of shop equipment. This device provides for many of the basic machining operations such as turning, facing, boring, drilling, reaming, and grinding and milling. The latter two operations are usually accomplished through the use of special attachments. However, in an effort to classify and identify the different types the following subclasses have been established:

a. Speed
b. Workshop
c. Engine
d. Toolroom
e. Special types (gap bed, wheel lathes, etc.)

Each of these subclasses is further described in Appendix A. In addition, lathes are further designated by their "size", a characteristic determined by two dimensions, the swing and the maximum distance between centers. The swing is the maximum diameter of work which can be rotated on the lathe while the distance between centers is in effect the maximum length of workpiece which can be mounted between centers.

The lathe in most applications is a device used for precision machining. It can be readily seen that if accuracy in the machined part is to be achieved then the machine must display greater accuracy. These factors, in effect, dictate the requirements for testing the lathe. The lathe is first subjected to extensive gauging and measuring procedures which examine under extreme accuracy the dimensions of individual parts and the dimensions between interconnected or interacting parts. Following this the lathe is used in its basic operations and the machined part is carefully measured in an attempt to determine how the errors in individual parts interact and affect the overall

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*This MTP is intended to be used as a basic guide in preparing actual test plans for the subject equipment. Specific criteria and test procedures must be determined only after careful appraisal of pertinent QMR's, SDR's, TC's and any other applicable documents.

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accuracy. The test item is also subjected to other additional evaluations which are required to provide a complete testing program for Army materiel.

3. REQUIRED EQUIPMENT

a. Transportability Test Facility.
b. Electromagnetic Interference (EMI) Facility-shielded Room or Open Area.
c. Machine Shop Facility
d. Weighing Scales.
e. Dielectric Strength Tester, 0-3000VRMS, 25-60 Hz.
f. 500 vdc megohmmeter.
g. Wheatstone Bridge.
h. EMI Field Intensity Equipment and Antennas per MIL-STD-461.
i. Temperature Measuring Devices, Thermometers °F., Thermocouples and Bridges.
j. Measuring Instruments per USASI B5.16.
k. Lubricating Oil and Grease.
l. Miscellaneous Hand Tools.
m. Rulers.
n. Inside Micrometer Calipers.
o. Vernier Caliper.
p. Precision Micrometers Calipers.
q. Levels and Gauges.
r. Protractor, Bevel.
s. Thread Gage.
t. SAE 1045 Carbon Steel Bars.
u. Dual Test Indicator Sets - .0005".

4. REFERENCES

A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
B. USATECOM Regulation 700-1, Value Engineering.
C. USATECOM Regulation 70-23, Equipment Performance Report.
D. USAGETA (HEDGE), Human Factors Evaluation Data for General Equipment.
E. MIL-STD-129, Marking for Shipment and Storage.
F. MIL-STD-130, Identification Marking of US Military Property.
G. MIL-STD-461, Electromagnetic Interference Requirements for Equipment.
H. MIL-STD-462, Electromagnetic Interference Characteristics, Measurement of.
I. MIL-STD-463, Definitions and Systems of Units - Electromagnetic Interference Technology.
J. MIL-STD-1186, Cushioning, Anchoring, Bracing, Blocking, and Waterproofing; with Appropriate Test Methods.
K. MIL-STD-810B Environmental Test Methods.
L. MIL-H-15424, Hand Tools, Packaging of.
M. MIL-P-116, Preservation, Methods of.
N. MIL-M-18058, Machinery, Metal and Wood-Working, Support Equipment

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and Associated Repair Parts, Preparation for Delivery of.

O. MIL-C-3774, Crates, Wood.
P. MIL-T-704, Treatment and Painting of Material.
Q. MIL-W-52574, Welding and Welding Procedure.
R. MIL-G-23827, Grease, Aircrafts and Instrument.
S. MIL-G-10924, Grease, Automotive and Artillery.
T. MIL-L-2104, Lubricating Oil, Internal Combustion Engine (Heavy Duty).
U. MIL-L-45199, Lubricating Oil, Internal Combustion Engine; Sub-zero.
V. MTP 6-2-509, Electromagnetic Compatibility.
W. MTP 9-2-503, Durability.
X. MTP 10-2-500, Physical Characteristics.
Y. MTP 10-2-501, Operator Training and Familiarization.
Z. MTP 10-2-503, Transportability.
AA. MTP 10-2-505, Human Factors Evaluation.
AB. MTP 10-2-507, Maintenance Evaluation.
AC. MTP 10-2-508, Safety.
AD. MTP 10-2-511, Quality Assurance.
AE. MTP 10-2-512, Reliability.
AF. NEMA MG-1, National Electric Manufacturer's Association Tests and Performance - AC and DC Fractional and Integral Horsepower Motors Part 12, 1966.
AG. Joint Industrial Council EGP-1-1967, Electrical Standards For General Purpose Machine Tools.
AH. USASI STANDARD B5.1, T-Slots, Their Bolts, Nuts, Tongues and Cutters.
AI. USASI Standard B5.9, Spindle Noses.
AJ. USASI Standard B5.10, Machine Tapers.
AK. USASI Standard B5.16, Accuracy of Engine and Toolroom Lathes.
AL. USASI Standard B5.22, Single Point Tools and Tool Posts.
AM. USASI Standard B6, Spur Gear Tooth Form.
AN. USASI Standard B6.6, Gear Tolerance and Inspection.
AO. AMCP 706-134, Maintenance Guide for Design.

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following tests to be conducted on lathes:

a. Preparation for Test - A determination of the condition of the test item upon its arrival and other preparatory procedures to be completed prior to the start of active testing. These will include the following:

1) Packaging and test item inspection
2) Inventory check
3) Physical characteristics
4) Operator training and familiarization
5) Pre-operational checks

b. Operational Performance - An evaluation to examine specific operational design characteristics including the test item's ability to perform its primary function. Test item controls and indicators will also be evaluated and checked.

c. Electromagnetic Interference - An evaluation to determine the degree to which the test item produced radiated or line conducted interference.

d. Durability - An evaluation of the test item's ability to display original physical and performance characteristics after an extended period of continuous operation.

e. Transportability - An evaluation to determine the ability of the test item and its container to withstand the forces which it will experience during normal handling and transporting.

f. Maintenance - An evaluation to determine and appraise the test item's maintenance characteristics and requirements, a verification and appraisal of its malfunctions, an evaluation of the test item's associated publications and other common and special support elements (maintenance test package), an appraisal of the test item's design maintainability (AMCP 706-134: accessibility, ease of maintenance, standardization, and interchangeability), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of appropriate preceding aspects.

g. Safety - An evaluation to determine the test item compliance with safety requirements and to confirm the test item's safety characteristics during conduct of all tests.

h. Human Factors Evaluation - An evaluation to determine the adequacy of the design and performance characteristics of the test item and associated equipment in terms of conformance to accepted human factors engineering design criteria. The sound noise level of the test item will also be determined.

i. Value Analysis - An evaluation directed at analyzing the primary functions and features of the test item for the purpose of reducing the cost of the test item without compromising the desired performance and safety characteristics.

j. Environmental Test - An evaluation to determine the effect of environmental changes on performance of the test item.

k. Quality Assurance - A review to determine and evaluate defects in material and workmanship.

5.2 LIMITATIONS

The procedures listed are applicable for electric motor driven lathes.

Lathes are for use in sheltered areas. Protection from environment is afforded by preservation, crating, etc.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

6.1.1.1 Shipping and Packaging Inspections

a. Examine the shipping method, preservation and packaging and determine any nonconformance with the following:

1) Wooden crates - MIL-C-3774.
2) Preservation, packaging, and packing of test item, support equipment and repair parts MIL-P-18058.
3) General preservation requirements - MIL-P-116.
4) Container markings - MIL-STD-129.
5) Packaging of provided hand tools - MIL-H-15424.
6) Blocking, bracing and anchoring procedures - MIL-STD-1186.

b. Record the following:

1) Evidence of damage or deterioration to packaging or shipping components and materials.
2) All identification markings.

c. Remove the test item from its shipping carrier, or container, and record the following:

1) All printed material accompanying the test item and agreement with test item markings.
2) Equipment, time and personnel required.
3) Comments regarding the method and materials used to secure the test item.

6.1.1.2 Test Item Inspection

The test item should have been marked in accordance with MIL-STD-130 and in addition the test item shall be visually inspected for evidence of defects, damage, and wear in its manufacturing, materials, and workmanship. In particular, the following will be considered:

a. Metal surfaces should have been treated for rust and/or painted in accordance with MIL-T-704. Paint shall be smooth and uniform without runs and sags.

b. Component junctions.

1) Bolted connections. Bolt holes shall be checked for being accurately punch or drilled and the burrs removed. Lockwashers shall be provided for all bolts, nuts, and screws. All fastenings shall be tight.
2) Riveted connections. Rivet holes shall be checked for being accurately punched or drilled and burrs removed. Rivets shall completely fill the holes. Rivet heads shall be full neatly made, concentric with the rivet holes, and in full contact with the surface of the member.
3) Welding shall be checked for conformance with MIL-W-52574 being free from slag, cracks, fractures, and having a smooth clean appearance.
4) Seams, joints and edges shall be checked for good fit and alignment and the absence of sharp edges or burrs.

6.1.2 Inventory Check

Verify completeness of the test item, its maintenance package and associated parts, accessories, and materials with the Basic Issue Item List (BIIL) and file an Equipment Performance Report (EPR), if required. The following should be included:

a. Repair parts.
b. Maintenance tools.
c. Technical publications.
d. Accessories such as cutting tools, collets, face plates, chucks, tape attachments, tool holders, arbors, etc.

6.1.3 Physical Characteristics

The physical characteristics of the test item shall be determined by performing the applicable sections of MTP 10-2-500, in particular the following:

a. Code markings - Note the legibility of test item markings and record all data.
b. Dimension and weight data - Record the dimensions and weights of all assembly components.
c. Test item specifications - Record the following: (All dimensions in inches unless otherwise denoted).

1) Lathe

a) Type
b) Swing over bed, minimum
c) Swing over cross slide, minimum
d) Distance between centers (tailstock flush with end of bed, basic machine) minimum

2) Bed

a) Width, minimum

3) Headstock

a) Hole diameter through spindle, minimum
b) Spindle center, ASA standard taper, minimum
c) Spindle speed changes, minimum
d) Spindle speed range, revolutions per minute
e) Spindle nose, type.

4) Carriage

a) Cross slide travel, minimum
b) Compound rest travel, minimum
c) Tool post, slotted to receive tool holder shank, minimum

5) Threads and feeds

a) Leadscrew diameter, minimum
b) Thread pitches, right and left hand, minimum
c) Thread range (threads per inch)
d) Number of feeds, minimum
e) Longitudinal feed (low), inches per revolution
f) Longitudinal feed (high), inches per revolution
g) Transverse feed (low) inches per revolution
h) Transverse feed (high) inches per revolution

6) Tailstock

a) Spindle diameter, minimum
b) Center, ASA taper, minimum
c) Spindle travel, minimum
d) Set over, minimum

7) Motor

a) Horsepower, minimum

8) Accessories

a) Collet chuck, spindle nose type, rated capacity, minimum
b) Face plate diameter, large maximum
c) Face plate diameter, small minimum
d) Chuck, diameter, 4-jaws, independent, minimum
e) Chuck, diameter, 3-jaw scroll, minimum
f) Steady rest, adjustable jaws, range

9) Environmental limitations

d. Verify that the assembly components are in accordance with the following standards:

1) Motors - NEMA MG-1
2) Electrical equipment (starters, relays, switches, etc.) conformance to and location - J.I.C. - Electrical standards for General Purpose Machine Tools.
3) Lathe components per USASI Standards

a) B5.1 T-Slots - their bolts, nuts, tongues and cutters
b) B5.9 Spindle Noses
c) B5.10 Machine Tapers
d) B5.22 Single Point Tools and Tool Posts
e) B6. Spur Gear Tooth Form
f) B6.6 Gear Tolerance and Inspection

6.1.4 Operator Training and Familiarization

Test personnel should undergo the applicable procedures of MTP 10-2-501.

6.1.5 Pre-Operational Checks

Perform the following:

a. Depreservation and assembly - remove all preservation from the test item and attach any devices which were removed from the test item for transporting convenience. Record all depreservation and assemblies procedures required and adequacy of the specified technical manual instructions for these procedures.

b. Lubrication - verify completeness of the lubrication program of the test item by the considering and examining for the following:

1) Oil holes, grease fittings, and drain plugs shall be accessible for service without disassembly but designed to exclude foreign material.
2) Pressure release fittings will be included where the pressure of lubricating equipment can damage grease seals.
3) Grease lubrication will be in accordance with the "Service on Receipt" and Lubrication Order sections of the technical manual and the following:

   a) MIL-G-23827 - for all instruments and sealed bearings (Military lubricants are not required for sealed bearings which cannot be disassembled and relubricated).
   b) MIL-G-10924 - for other application where operating temperatures do not exceed 175°F.
   c) MIL-G-23827 - for other applications where operating temperatures do not exceed 250°F.

4) Oil lubrication of the power train, transmission, and hydraulic system shall be as follows:

   a) MIL-L-2104 and MIL-L-45199 - high temperature operation.
   b) MIL-L-10295 - low temperature operation

5) A lubrication tag or chart shall be attached to the test item with the following information:

   a) Points of application
   b) Service interval
   c) Type of lubricant
   d) Viscosity
   e) Military specification number
   f) Temperature range

6) Units provided with reservoirs, reservoir level gauges, filters and pumping systems to the tool post will have all of these features checked for proper operation.

c. Units requiring the application of electrical power will have the

the following preliminary electrical measurements performed.

1) Continuity and short - using an ohmmeter, check power input leads and ensure that only the building ground lead is connected to the test item housing and that no shorts exist between the other leads.
2) Dielectric strength - using a dielectric strength tester, (0-3000VRMS, 25-60 Hz) test each electrical circuit according to the stated criteria.
3) Insulation resistance (IR) - using a 500 vdc megohmmeter, check each electrical circuit for insulation resistance.

d. Mechanical adjustments and levers - check all of these for smoothness of movement, lack of binding or rubbing, etc.

e. Electrical controls and indicators - operate and check each individually for proper operation.

f. Gearing, speed, and feed controls - check each for proper operation and desired effect on the test item.

g. Limit, overload, overtravel, and interlock switches will be checked for proper operation.

h. Accuracy Tests.

The lathe and its components shall be subjected to the accuracy measurements of USASI Standard B5.16 by performing the following checks:

1) Bed level - transverse direction
2) Bed level - longitudinal direction
3) Tailstock way alignment
4) Headstock spindle center runout
5) Headstock spindle nose runout
6) Cam action of headstock spindle
7) Headstock spindle taper runout
8) Headstock alignment - vertical
9) Headstock alignment - horizontal
10) Tailstock spindle alignment - horizontal
11) Tailstock spindle alignment - vertical
12) Tailstock taper alignment - horizontal
13) Tailstock taper alignment - vertical
14) Vertical alignment of head and tail centers
15) Lead screw alignment
16) Lead screw cam action
17) Cross slide alignment
18) Face plate runout
19) Chuck runout
20) Collet chuck runout

6.2 TEST CONDUCT

Note: 1. All equipment malfunctions shall be reported in accordance with USATECOM Regulation 70-23.
2. During the conduct of all tests, test personnel shall

observe the proper safety precautions.

6.2.1 Operational Performance

6.2.1.1 Operational Test

Perform the following:

a. Apply power to the lathe.
b. Run at no load continuously for not less than 30 minutes.
c. Check all controls, adjusting mechanisms, etc. for proper operation.
d. Operate the lathe through the range of spindle speeds available and at different feed rates.
e. Observe that all parts function smoothly and without evidence of binding, abrupt changes in motion, excessive noise, etc.

6.2.1.2 Performance Tests

The lathe shall be subjected to the following tests. The material used shall be SAE 1045 carbon steel or equal. The bar shall be the appropriate size. Tools used shall be as required, and the cutting speeds and feeds shall be the maximum for the type material, type tool and type cut. The work piece shall be mounted between centers with the tailstock center protruding not less than 1/3 of its total travel.

Perform the following operations:

a. Rough Cut:

1) Using a 1/4 inch depth of cut, rough turn the work piece between centers using a single cut (Figure 2) of 12 inches.
2) During the test observe that the kickback of the carriage with respect to the bed does not exceed 0.001 inch, and the deflection of the tailstock spindle does not exceed 0.002 inch when checked 1/8 inch back from the face end of the tailstock spindle.
3) Measure and record the diameters of the work piece at locations 1 and 2 of Figure 2 in inches using a precision micrometer.

b. Finish Cut:

1) Without removing the work piece, apply a finish cut of depth approximately 0.01 inch.
2) Measure diameter at locations 1 and 2 taking two measurements at each location 90° apart to determine roundness and taper. Record the 2 measurements at each location inches and the distance between measuring locations in inches.

c. Threading Test:

1) Using the same piece of steel used for the above tests machined to 2 1/2 inches, thread the workpiece with an 8 pitch thread in accordance with Figure 3.
2) The lead screw shall not be disengaged on the finishing cuts of a section while passing over the relieved portion as the continuity of the lead must be maintained over the entire section.
3) It is not necessary that section 1 and section 2 be chased on the same engagement of the nut, i.e., one section can be completely finished before proceeding with the other.
4) Using a thread gauge measure the lead error over any random (1) inch section and also on any random (4) inch section. Record the error in inches for both measurements.

d. Taper Test

1) If a taper attachment is specified, use the same piece of steel and turn it to conform to Figure 4.
2) Record whether the taper attachment was set to the matched line or a master taper gage.
3) Using a precision protractor and a precision level block or bevel protractor measure and record the angles of the A and B sections in degrees.

e. Boring Test

1) Obtain a cast iron or low carbon steel piece approximately (6) inches in diameter and which extends (6) inches from the face of and supported only by the chuck used in the test.
2) Drill a hole of approximately (4) inches in diameter and (4) inches deep.
3) Use a caliper type inside micrometer to measure the diameter at several points to enable the determination of roundness of the hole.
4) Use a set of outside calipers to measure and record the wall thickness at various depths and points around an inside circumference at each depth. These measurements will be used to determine the straightness of the hole.

f. Other Tests

Depending on the test item QMR, TC's, etc., other subtests will be designed and run to test the particular or special features required, such as environmental or exceptional accuracy.

6.2.2 Electromagnetic Interferences

This test is required on all test items which require the application of external electrical power for control and/or drive units. The test shall be conducted in accordance with the requirements of MIL-STDS-461, 462, 463, and

MTP 6-2-509. In particular, the subtests required of the MIL-STD-461 Class IIB equipment shall consist of the following:

TEST	DESCRIPTION
CE03	150 KHz to 50 MHz, Power Leads
CE05	30 Hz to 50 MHz, Inverse Filter Method
CE01	0.03 to 30 KHz, Magnetic Field
RE02	150 KHz to 400 MHz, Electric Field
(T)RE04	0.02 to 50 KHz, Magnetic Field

Perform the following:

a. Obtain the measuring equipment and antennas required by MIL-STD-461.

b. Calibrate the equipment where required.

c. Have the test item in a normal operating configuration under the test conditions specified by MIL-STD-462.

d. Conduct the subtests listed above, recording frequencies and levels of interference.

e. Compare the interference readings against the allowable limit graphs of MIL-STD-461 and note out-of-tolerance readings.

6.2.3 Durability

Perform the applicable portions of MTP 9-2-503 and the following: Conduct an evaluation for 100 continuous hours with a "Metal removal test" performed once during each elapsed (5) hour period. The QMR, however, supersedes these requirements if they are different.

Perform the following:

a. Connect wattmeters into the test item power leads to enable monitoring of the test item power consumption.

b. Attach temperature measuring equipment, e.g., thermometers, thermocouples, etc., to the housing of the test item drive motor. If the motor is not accessible, place the devices in the drive compartment as close as possible to the motor.

c. For the metal removal check, obtain (20) bars of SAE 1045 carbon steel or equal which are long enough to allow a cut of lenth (10) inches, or as required according to the size of the lathe.

d. With no work piece on the lathe, apply power and record the starting time. Have the spindles running at maximum rpm and where applicable the feed mechanisms in operation.

e. At the end of each (5) hour elapsed period record the power consumption in watts and temperature in °F. Load the steel bar on the lathe between centers and make a (10) inch long cut using a depth of cut and rate of feed to produce a metal removal rate of at least (1) cubic inch per minute per horsepower rating of the equipment motor. Record any evidence of chatter and and when complete, any gross changes in the power consumption or temperature.

f. When the test is complete, examine the complete assembly for any

damage or signs of accelerated wear.

g. For each defect revealed by section e. record the nature of the defect and location.

NOTE: In the event of equipment malfunction during the durability test, the procedures of the maintenance section will be performed and the durability test rerun following repair.

6.2.4 Transportability

Perform the applicable portions of MTP 10-2-503. The appropriate test below is in accordance with the packaging and weight characteristics of the test item as follows:

I. Test A - Test item in a box and weight greater than 100 pounds, MIL-STD-810B Method 576.

II. Test B - Test item in a crate per MIL-STD-1186, Guided impact test in Appendix A of MIL-STD-1186.

The technical manual shall be reviewed or consulted for proper procedures for tying down and lifting, and transporting the item by various media. Any inadequacy of instructions should be reported by EPR.

6.2.5 Maintenance

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 and 10-2-512 with emphasis on the following:

a. Organizational (O), Direct Support (F), and General Support (H) maintenance requirements.
b. Operator through General Support Maintenance Literature.
c. Repair Parts.
d. Tools.
e. Test and handling equipment.
f. Calibration and maintenance facilities.
g. Personnel skill requirements.
h. Maintainability.
i. Reliability.
j. Availability.
k. Proper use and care of accessories.

In evaluating the above listed factors, perform the following:

NOTE: Particular attention should be paid to whether part numbers have been properly corrected or provided to cross-reference identification from manufacturer's to FSN.

a. Obtain copies of the manufacturer's mechanical and electrical drawings and draft technical manuals, if required.
b. Examine the operational portion of the manual and insure that all

required operational procedures and use of accessory items are adequately covered.

c. Examine the maintenance section of the test item draft manual and/or drawings for the following:

1) Programs of periodic (preventive) and major maintenance shall be given.
2) A list of recommended repair parts and maintenance tools shall be given.

d. Evaluate the maintenance data against the test item by the following:

1) Ensure that the procedural instructions are accurate and sufficient to accomplish the task.
2) Verify that the recommended tools, equipment and repair parts are sufficient for the maintenance procedures.

e. Examine the design of the test item with regard to the maintenance program and note the following:

1) Components are removable with a minimum of dismantling for access.
2) Maintenance monitoring and service points and adjustment mechanisms are accessible.

f. Where failures occur during testing the following will be recorded to allow for the determination of the maintainability, reliability, and availability figures, using the Durability operating time to base calculations for maintainability, reliability, and availability.

1) Indication of the failure.
2) Component or feature involved and the method used to determine it.
3) Elapsed run time since previous test item failure.
4) Total accumulated run time of the failing component.
5) Any damage caused to associated parts of the test item by the failing component.
6) Repair procedures followed, downtime, and personnel, material and tools required.

6.2.6 Safety

Perform the applicable sections of MTP 10-2-508 and the following:

NOTES: 1. Provide a safety statement in accordance with the USATECOM Regulation 385-6, and the test directive, as applicable.
2. During the conduct of all tests, test personnel shall observe the proper safety precautions and, in particular, shall adhere closely to the draft manual for the handling and use of the test item.

3. The procedure for all tests and the test item shall be examined and any condition which might constitute a safety hazard shall be recorded and also reported to the testing officer.

Perform the following:

a. Examine the general safety characteristics of the test item to determine whether its design incorporates generally accepted criteria for a safety program. Include the following:

1) Where unsafe conditions cannot be avoided, is the item properly and conspicuously marked for the condition.
2) Are all moving parts shielded and properly enclosed.
3) Where electrical power is utilized, are the electrical circuits guarded against accidental contact and properly grounded.

b. Prepare a list of all safety devices included on the test item. Consider the following:

1) Overheat devices
2) Overload
3) Locking mechanisms
4) Limit switches
5) Safety brakes
6) Ratchet and pawl assembly
7) Interlocks

c. For each device listed, a minimum of 2 cycles of operation will be caused by simulating the type failure which the device is to detect or otherwise utilizing the feature. Record the following:

1) The device/feature tested
2) Failure which the device is to detect
3) Proper operation of the device or failure detected.

d. Examine the test item for the possible additions and/or improvements to its safety characteristics. Record any recommendations.

6.2.7 Human Factors Evaluation

The procedures required by MTP 10-2-505 will be performed, and the following:

This evaluation is designed to determine the degree to which the design and performance of the test item satisfy accepted standards for human factors. The applicable portions of the HEDGE (Human Factors Evaluation Data for General Equipment) will be used for the test. In particular, checklists will be prepared for all tasks associated with the HEDGE Class III C (Operational Support Equipment for Production/Modification of Materiel or Conditions)

test functions which rate the task from a human factors standpoint as either satisfactory or not satisfactory. Note that in some instances the HEDGE test functions and subtests may be under consideration during the conduct of other tests. Where this condition exists, the HEDGE requirements will be integrated into and conducted simultaneously with the corresponding tests. Perform the following:

a. For all tasks the following factors will be considered:

1) Adequacy of instructions and tools to perform the task.
2) Mental and physical effort required.
3) Design of the test item as it affects the task.
4) Time required for the task
5) Personnel required for the task

b. Perform the following tasks for the HEDGE test functions given. The factors considered shall include, but not be limited to, those of section a. above.

1) Operability

a) Assemble and set-up

(1) Assemble components, move to test site, and place in position, make all external connections.
(2) Make preliminary alignment, calibrate and adjust.

b) Prepare

(1) Check controls, fasteners, connectors
(2) Load expendables (lubricants, etc.)
(3) Close covers, caps, etc.

c) Produce or modify

(1) Turn on electrical power, energize lubricant flow.
(2) Operate-manipulate controls, observe indicators, observe effect on material, remove finished product.

2) Maintainability

a) Perform preventative maintenance

(1) Clean, add lubricants
(2) Remove and replace minor items
(3) Tighten fasteners, connectors
(4) Adjust, calibrate, align

b) Perform non-scheduled maintenance

(1) Detection of malfunction by observing displays,

noting visual or audible changes, or changes in operating effectiveness.
(2) Isolate and identify causes by visual means or instrumentation.

c) Remove and Replace

(1) Open, gain access to and remove component.
(2) Replace or repair and re-establish proper operation

3) Transportability

a) Prepare for transport

(1) Place in the transit state by removals, tightening, locking, remove fluids, apply protective cover.
(2) Package/containerize the test item.

b) Load/unlaod

(1) Move test item by appropriate MHE to the carrier.
(2) Place test item into/onto the carrier.

c) Secure/unfasten

(1) Tie down or secure.
(2) Open container, remove and reinstall test item.

6.2.8 Value Analysis

During the conduct of all tests, personnel shall examine the materials, construction, and design of the test item from a value standpoint in an effort to affect cost reduction of the test item. USATECOM Regulation 700-1 shall serve as a basis for this evaluation. Perform the following:

a. Examine the test item in the following cost reduction areas:

1) Deletion of ineffective or unnecessary features or components.
2) Substitution of less expensive but comparable component or material.
3) Changes in the design to reduce the cost of manufacturing.

b. Examine all proposals to determine that the performance and safety characteristics have not been lowered.

c. Record the following for each suggested change:

1) Component or feature involved
2) Suggested change
3) Reasons for the suggestion

6.2.9 Environmental Test

Subject the test item to extreme environmental conditions according to MIL-STD-810. Record the results.

6.2.10 Quality Assurance

Determine the quality of the test item as described in the applicable sections of MTP 10-2-511.

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon those data procedures which are other than quantitative in nature by recording narrative descriptions and/or events occurring during the conduct of the test.

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

6.3.1.1.1 Shipping and Packaging Inspection -

Record the following:

a. Any noncompliance with the standards for shipping, marking, preservation, and packaging.
b. Evidence of damage, identification markings, and list of printed matter enclosed.
c. Equipment, time, and personnel required to unpack the test item and comments concerning the method and materials used in packing.

6.3.1.1.2 Test Item Inspection -

Record the following:

a. Any instances of noncompliance with the marking requirements of MIL-STD-130.
b. Evidence of defects in the manufacturing, materials, and workmanship or nonconformance with referenced standards.

6.3.1.2 Inventory Check

List any materials missing from the Basic Issue Item List.

6.3.1.3 Physical Characteristics

Record the data required by MTP 10-2-500 and the following:

a. Test item code markings.
b. Dimension and weight data.
c. Test item specifications:

1) Lathe

   a) Type.
   b) Swing over bed, minimum.
   c) Swing over cross slide, minimum.
   d) Distance between centers. (tailstock flush with end of bed, basic machine) minimum.

2) Bed

   a) Width, minimum.

3) Headstock

   a) Hole diameter through spindle, minimum
   b) Spindle center, A.S.A. standard taper, minimum
   c) Spindle speed changes, minimum
   d) Spindle speed range, revolutions per minute
   e) Spindle nose, type

4) Carriage

   a) Cross slide travel, minimum
   b) Compound rest travel, minimum
   c) Tool post, slotted to receive tool holder shank, minimum.

5) Threads and feeds

   a) Leadscrew diameter, minimum
   b) Thread pitches, right and left hand, minimum
   c) Thread range (threads per inch)
   d) Number of feeds, minimum
   e) Longitudinal feed (low), inches per revolution
   f) Longitudinal feed (high), inches per revolution
   g) Transverse feed (low) inches per revolution
   h) Transverse feed (high) inches per revolution.

6) Tailstock

   a) Spindle diameter, minimum
   b) Center, A.S.A. taper, minimum
   c) Spindle travel, minimum
   d) Set over, minimum

7) Motor

   a) Horsepower, minimum

8) Accessories

   a) Collet chuck, spindle nose type, rated capacity, minimum

b) Face plate diameter, large minimum
c) Face plate diameter, small, minimum
d) Chuck, diameter, 4-jaws, independent, minimum
e) Chuck, diameter, 3-jaw, scroll, minimum
f) Steady rest, adjustable jaws, range

9) Environmental limitations.

d. Any instances where components are not in accordance with listed specifications.

6.3.1.4 Operator Training and Familiarization

Record the data required by MTP 10-2-501 and the following:

a. Methods used and completion of test personnel training and evaluation of the technical manuals.
b. Evidence that the test personnel are sufficiently knowledgeable in objectives and procedures.
c. The personal data required for selected personnel.

6.3.1.5 Pre-Operational Checks

Record the following:

a. Depreservation procedures utilized.
b. Any assembly required.
c. Lubrication procedures, materials, and data on tag.
d. Ineffective or inoperative coolant system.
e. Preliminary electrical tests.

1) Shorted or open power leads or unconnected ground lead.
2) Dielectric test failures, identify the circuit.
3) The insulation resistance (IR) in megohms.

f. Mechanical adjustments which rub, bind or are not smooth.
g. Inoperative electrical controls or indicators.
h. Gearing, speed and feed controls which are inoperative.
i. Limit, overload, overtravel and interlock switches which do not function.
j. List the results of the accuracy tests in the form required by USASI.

6.3.2 Test Conduct

6.3.2.1 Operation Performance

6.3.2.1.1 Operational Test -

Record any difficulties, malfunctions, etc. experienced during the (30 minute) run-in period.

6.3.2.1.2 Performance Tests -

Record for the test denoted the following:

a. Rough Cut - excessive kickback of lathe components and the diameters at the two measuring points in inches.
b. Finish Cut - the (2) diameter measurements at each location in inches and the length (L) between measuring locations in inches.
c. Threading Test - the lead error over the (1) inch section and over the (4) inch section, both in inches.
d. Taper Test - the taper angles of sections A and B in degrees.
e. Boring Test - the hole inside diameter measurements in inches, and the wall thickness measurements in inches.

6.3.2.2 Electromagnetic Interfernece

a. Prepare a diagrammatic layout of the test site showing the test item and locations at which measurements were made.
b. Record for each test and its frequency band, the frequency and its corresponding highest in-band interference reading.

6.3.2.3 Durability (Including Temperature Rise)

Record the following data in addition to that required by MTP 9-2-503:

a. Prepare a table and record the time measured from the start of the test, in hours, the temperature, °F, and the power consumption, watts taken at successive measuring intervals.
b. Any malfunction or problems encountered during the metal removal checks.
c. Any lubrication procedures utilized.
d. Post test physical examination.

1) Damage to any component, material or finish
2) Loosening of hardware, breaks in welds
3) Excessive temperatures on the enclosure
4) Signs of leakage

e. For each defect of section d., record the nature, location, and recommended remedy.

6.3.2.4 Transportability

Record the data required by MTP 10-2-503 and the following:

a. The test used.
b. The types, numbers, and heights of drop used in the test.
c. The locations and types of damage which the test item container exhibits and any breakage, shifting, etc. of the container contents.
d. Any damage to the test item or impairment of its operating

efficiency. Include details as to location and nature of the fault.

6.3.2.5 Maintenance

Record the data required by MTP 10-2-507, MTP 10-2-512 and the following:

a. Deficiencies in the draft manual maintenance literature.
b. Ineffective maintenance procedureal instructions.
c. Design defect in the test item which hinders maintenance procedures.
d. Details of all maintenance procedures utilized.
e. For each malfunction, record the following:

1) Indication of the failure.
2) Component or feature involved and the method used to determine it.
3) Elapsed run time since previous test item failure.
4) Total accumulated run time of the failing component.
5) Any damage caused to associated parts of the test item by the failing component.
6) Repair procedures followed, downtime, and personnel, material and tools required.

6.3.2.6 Safety

Record the data required by MTP 10-2-508 and the following:

a. Comments regarding unsafe conditions found in the procedures of any test.
b. Prepare a table to include the following:

1) A list of all safety devices used on the test item.
2) The type of failure each device is to detect.
3) Indication that the device has successfully passed two cycles of operation.

c. List any missing devices or unsafe conditions.
d. List any suggested additions to the test item's safety features.

6.3.2.7 Human Factors Evaluation

Record the data required by MTP 10-2-505 and the following:

Prepare checklists for the various tasks associated with each test function. The rating of each task, being either satisfactory or unsatisfactory, will be determined by considering the effects which the human factors characteristics of the test item have on the accomplishments of the task.

6.3.2.8 Value Analysis

Record the following:

a. The component or feature involved
b. Suggested change
c. Reasons for the suggested change

6.3.2.9 Environmental Tests

Record the effects of extreme conditions on the test item.

6.3.2.10 Quality Assurance

Record data collected as described in the applicable section of MTP 10-2-511.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Pre-operational Checks

Compare the results of the accuracy tests to the USASI B5.16 Standard or other governing document and note differences.

6.4.2 Operational Performance

Perform the following:

a. For the rough cut test, compare the measured diameter against the governing specification and note differences.
b. For the finish cut test, compute the roundness at each location by the following:

$$R = 1 - \frac{M_1}{M_2}$$

where M_1 and M_2 are the diameter measurements of each location and $M_2 = M_1$ and R=0 implies perfect roundness.

Using the (2) computed values for diameter at the (2) measuring locations compute the average diameter:

$$M_I = \frac{M_1 + M_2}{2} \text{ (inches)}$$

Compute the taper (inches difference per length distance between measuring locations):

$$T = \frac{M_A - M_B}{L}$$

Where M_A, M_B are the average diameters at measuring locations and L is the distance between measuring locations.

c. For the threading test compare the lead errors against the governing specification and record differences.
d. For the taper test, repeat step c. for the measured angles.
e. For the boring test compute the roundness of the hole as in section b. using the measured inside diameters and determine the straightness

of the hole by computing the average wall thickness at several normal planes down the length of the hole and noting differences.

6.4.3 Electromagnetic Interference

Prepare a table showing the interference test conducted, out-of-limit readings, or the highest reading in the band and corresponding frequency. Consult the graphs of MIL-STD-461 for maximum allowable readings.

6.4.4 Durability

Using the table compiled during the test, mark any readings which indicate gross changes during the test and analyze for possible causes.

Tabulate and summarize the remaining data as appropriate. All data shall be compared with the technical performance characteristics specified in the QMR's, SDR's, or other specifications.

APPENDIX A

LATHE CLASSIFICATION

Speed Lathes - These lathes are usually equipped with a headstock, tailstock, and a simple tool post mounted on a light bed. They have three or four spindle speeds available through a belt-driven, step-cone pulley with spindle speeds up to about 4000 rpm. These devices are used primarily for wood turning, polishing or metal spinning.

Workshop Lathes - Usually found in small industrial operations. They have up to an 11 inch swing and 12-18 inches between centers. Many are designed for bench mounting, having a combination lead screw/feed rod with provision for about 20 speeds and an equal number of thread cuttings. This unit requires the changing of gears in the gear train to obtain a full range of power feeds. Usually 6 or 8 spindle speeds are available with a step V belt pulley and a simple back-gear system.

Engine Lathes - This type is the most frequently found type in industry. They are heavy duty machines with all the normal components and power drive for all tool movements except on the compound rest. There are two types available differing mainly in the mounting. The bench type is for bench mounting and the pedestal type stands on legs at each end of the bed. However in recent years, lathes have been made which can be bench mounted or pedestal leg mounted and the clear difference between a bench and a regular engine lathe has vanished. As such the term "bench lathe" is not used and the members of this class are referred to as either bench-type or pedestal type engine lathes. In general, the bench types are smaller, do not usually have over a 13 inch swing, and are for light work. Their accuracy may be as good as the pedestal type and they have all of the usual power features. Pedestal types are available in an almost unlimited number of sizes. The most common have 12-14 inch swing and 24-48 in center distances,with 50 inch swings and 12 feet center distances not uncommon. Most of these units have a headstock pedestal motor mount, built in coolant circulating, and a chip pan.

Toolroom Lathes - These are either bench or pedestal type with greater accuracy and wide ranges of speed and feed. Some are equipped with continuously variable spindle speed. They are usually used for machining small parts and their beds are frequently shorter than standard engine lathes with comparable swing dimensions.

Special Lathes - These types are designed to accommodate a specific type of work. One is the gap bed lathe. On this type there is a section of the bed adjacent to the headstock which is removed so as to permit an unusually large diameter work piece to be swung. Another type is the wheel lathe which is used to turn the journals and wheel treads of railroad car wheel and axle assemblies. One such unit for this purpose has a special headstock which drives the wheel and axle assembly at a point on the axle between the (2) wheels.

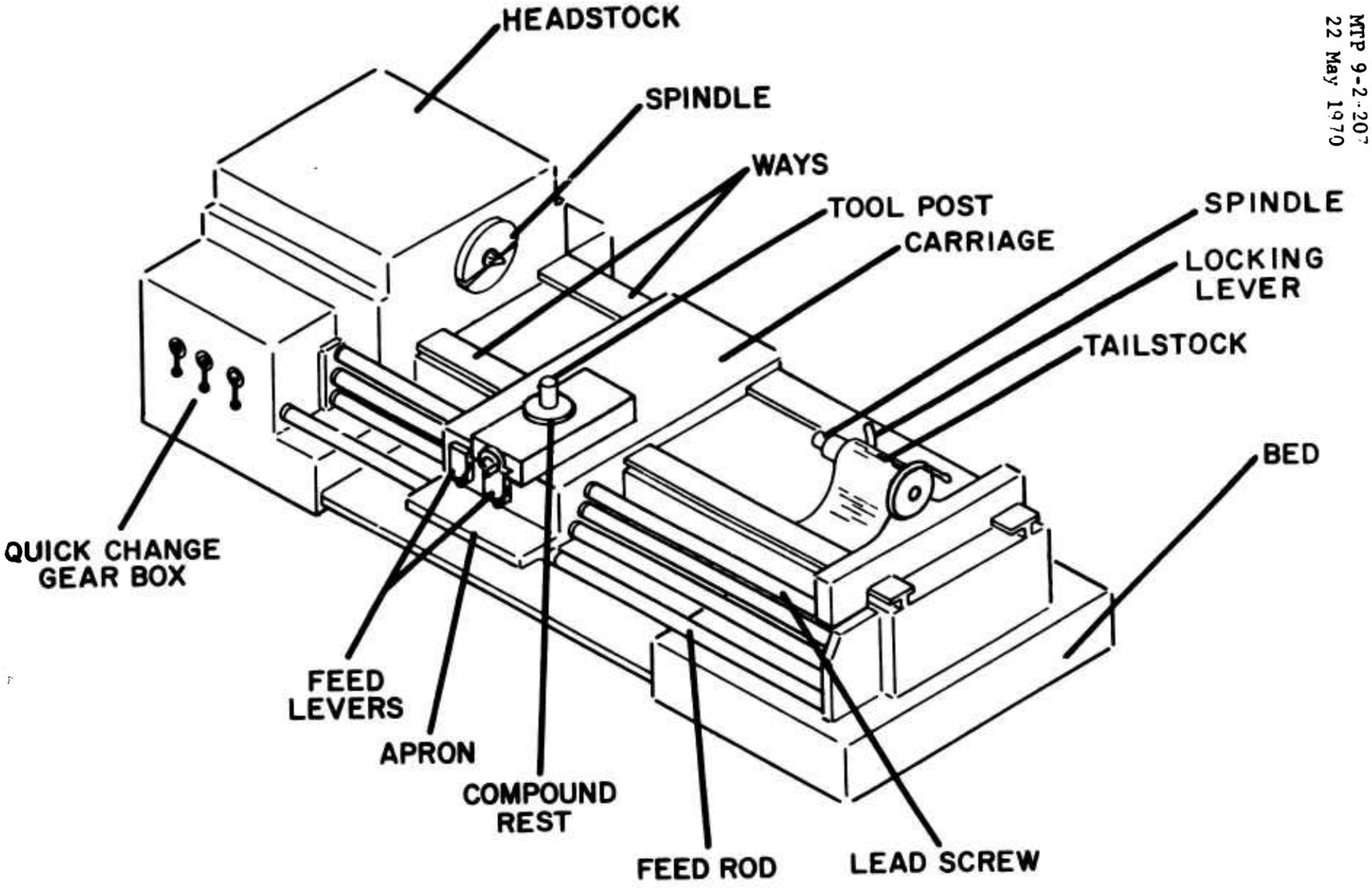

FIGURE 1 ELEMENTS OF THE LATHE

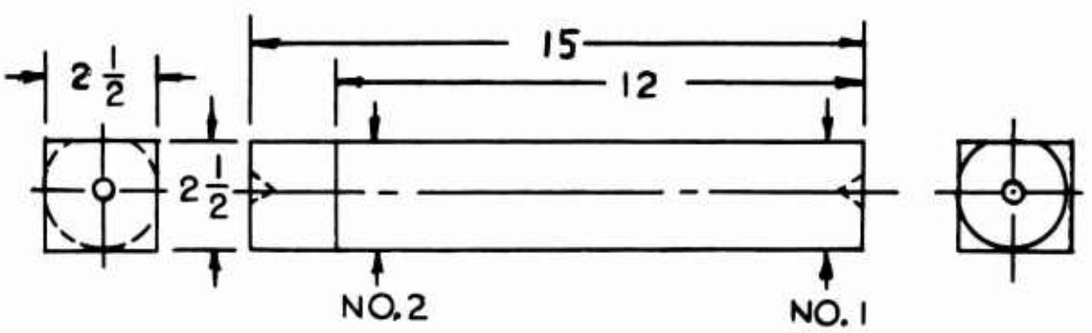

FIGURE 2 TURNING TEST BAR

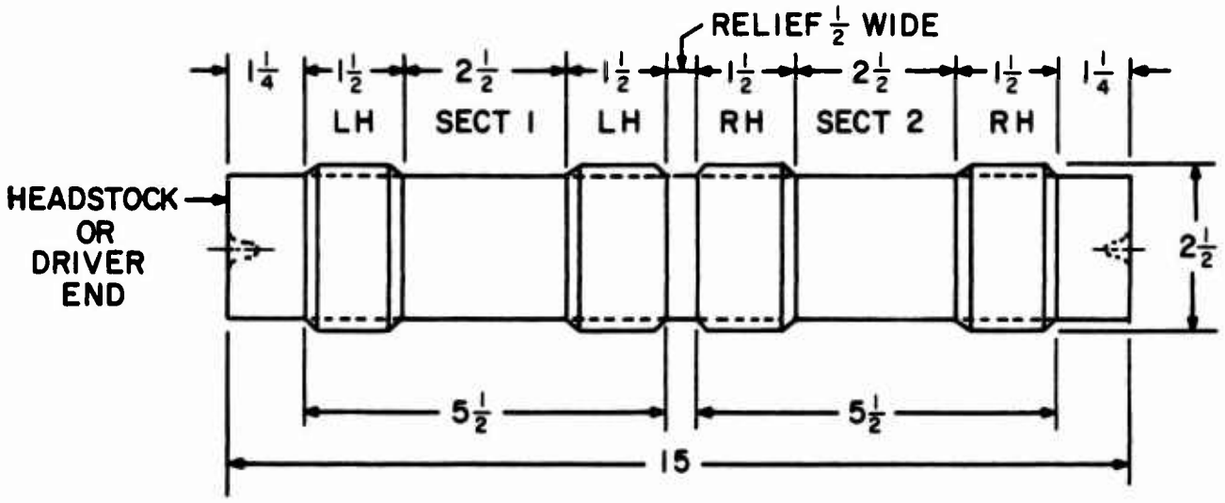

FIGURE 3 THREADING TEST BAR

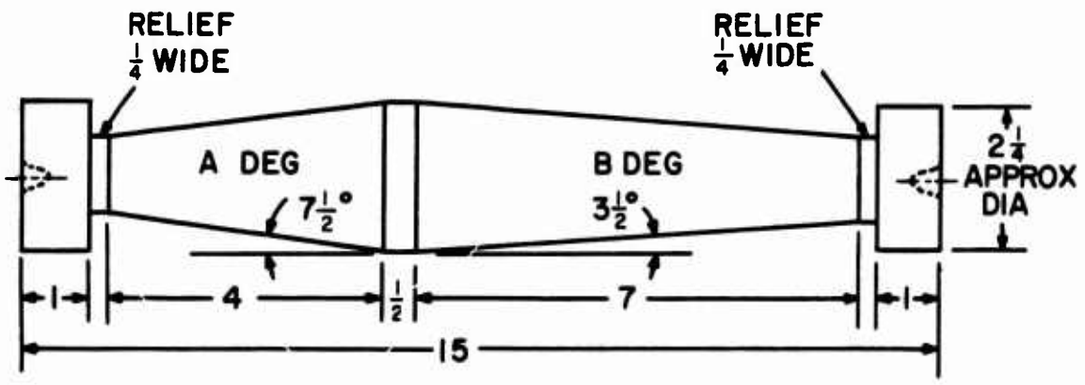

FIGURE 4 TAPER TEST BAR

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13 ABSTRACT
This Engineering Test Procedure describes test methods and techniques for evaluating the technical performance and characteristics of Lathes, and for determining their suitability to be subjected to further test for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

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